

CLAIMS

1- A method for determining a velocity of ultrasound propagation in a drilling fluid in a downhole environment, comprising:

- disposing a first ultrasound transducer (37) adjacent to a second ultrasound transducer (39) such that the front face (37f) of the first transducer (37) is offset from the front face (39f) of the second ultrasound transducer (39) by a predetermined radial offset distance (ΔD_f);
- emitting an ultrasound pulse into the drilling fluid in a borehole using the first ultrasound transducer (37);
- detecting the ultrasound pulse after the ultrasound pulse has travelled through the drilling fluid a distance (d); and
- determining the velocity of ultrasound propagation from the distance (d) and the travel time (t).

2- The method according to claim 1, wherein the detecting the ultrasound pulse is performed with the first ultrasound transducer (37).

3- The method according to claim 1, wherein the detecting the ultrasound pulse is performed with the second ultrasound transducer (39).

4- The method according to claim 1, wherein the detecting the ultrasound pulse is performed with both the first and second ultrasound transducer.

5- The method according to claim 4, further comprising determining a borehole diameter (D_{bh}) using the predetermined offset distance (ΔD_f) and a difference in travel times ($T_2 - T_1$) for the ultrasound pulse to be detected by the first ultrasound transducer (37) and the second ultrasound transducer (39).

6- The method according to claim 1, wherein the detecting the ultrasound pulse is performed by the first ultrasound transducer (37), and wherein the method further comprises:

- emitting a second ultrasound pulse into the drilling fluid in the borehole using the second ultrasound transducer (39); and

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detecting the second ultrasound pulse after the second ultrasound pulse has traveled through the drilling fluid a distance ($c + 2\Delta D_f$) using the second ultrasound transducer (39).

7- The method according to claim 6, wherein the ultrasound pulse and the second ultrasound pulse are emitted simultaneously.

8- The method according to any of claims 1 to 7, wherein the drilling fluid is located in an annulus between a tool and a borehole wall.

9- An apparatus for determining a velocity of ultrasound propagation in a drilling fluid in a downhole environment, comprising:

a first ultrasound transducer (37) disposed on a tool; and

a second ultrasound transducer (39) adjacent to said first ultrasound transducer such that the front face (37f) of the first transducer (37) is offset from the front face (39f) of the second ultrasound transducer (39) by a predetermined radial offset distance (ΔD_f).

circuitry (82) for controlling a timing of an ultrasound pulse transmitted by the first ultrasound transducer (37) and for measuring a time lapse between ultrasound transmission and detection after the ultrasound pulse has traveled a distance (d).

10- The apparatus according to claim 9, wherein the first ultrasound transducer (37) and the second ultrasound transducer (39) are disposed on an outside surface of the tool.

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